

## CHECK ANALYSIS TOLERANCES

[A heat of steel made under any of the above grades, the ladle analysis of which is slightly out of the specified range is acceptable if the check analysis is within the following variations:]

Element	Limit or maximum specified (percent)	Tolerance (percent) over the maximum limit or under the minimum limit	
		Under minimum limit	Over maximum limit
Carbon .....	To 0.15 inclusive .....	0.02	0.03
	Over 0.15 to 0.40 inclusive .....	0.03	0.04
Manganese .....	To 0.60 inclusive .....	0.03	0.03
	Over 0.60 to 1.15 inclusive .....	0.04	0.04
	Over 1.15 to 2.50 inclusive .....	0.05	0.05
Phosphorus <sup>7</sup> .....	All ranges .....		0.01
Sulfur .....	All ranges .....		0.01
Silicon .....	To 0.30 inclusive .....	0.02	0.03
	Over 0.30 to 1.00 inclusive .....	0.05	0.05
Copper .....	To 1.00 inclusive .....	0.03	0.03
	Over 1.00 to 2.00 inclusive .....	0.05	0.05
Nickel .....	To 1.00 inclusive .....	0.03	0.03
	Over 1.00 to 2.00 inclusive .....	0.05	0.05
Chromium .....	To 0.90 inclusive .....	0.03	0.03
	Over 0.90 to 2.10 inclusive .....	0.05	0.05
Molybdenum .....	To 0.20 inclusive .....	0.01	0.01
	Over 0.20 to 0.40 inclusive .....	0.02	0.02
Zirconium .....	All ranges .....	0.01	0.05
Columbium .....	To 0.04 inclusive .....	0.005	0.01
Aluminum .....	Over 0.10 to 0.20 inclusive .....	0.04	0.04
	Over 0.20 to 0.30 inclusive .....	0.05	0.05

<sup>7</sup> Rephosphorized steels not subject to check analysis for phosphorus.

[Amdt. 178–3, 34 FR 12283, July 25, 1969; 34 FR 12593, Aug. 1, 1969, as amended by Amdt. 178–64, 45 FR 81573, Dec. 11, 1980; Amdt. 178–97, 55 FR 52728, Dec. 21, 1990; 68 FR 75758, Dec. 31, 2003]

## APPENDIX B TO PART 178—ALTERNATIVE LEAKPROOFNESS TEST METHODS

In addition to the method prescribed in §178.604 of this subchapter, the following leakproofness test methods are authorized:

(1) *Helium test.* The packaging must be filled with at least 1 L inert helium gas, air tight closed, and placed in a testing chamber. The testing chamber must be evacuated down to a pressure of 5 kPa which equals an over-pressure inside the packaging of 95 kPa. The air in the testing chamber must be analyzed for traces of helium gas by means of a mass spectrograph. The test must be conducted for a period of time sufficient to evacuate the chamber and to determine if there is leakage into or out of the packaging. If helium gas is detected, the leaking packaging must be automatically separated from non-leaking drums and the leaking area determined according to the method prescribed in §178.604(d) of this subchapter. A packaging passes the test if there is no leakage of helium.

(2) *Pressure differential test.* The packaging shall be restrained while either pressure or a vacuum is applied internally. The packaging must be pressurized to the pressure required by §178.604(e) of this subchapter for the appropriate packing group. The method of restraint must not affect the results of the

test. The test must be conducted for a period of time sufficient to appropriately pressurize or evacuate the interior of the packaging and to determine if there is leakage into or out of the packaging. A packaging passes the pressure differential test if there is no change in measured internal pressure.

(3) *Solution over seams.* The packaging must be restrained while an internal air pressure is applied; the method of restraint may not affect the results of the test. The exterior surface of all seams and welds must be coated with a solution of soap suds or a water and oil mixture. The test must be conducted for a period of time sufficient to pressurize the interior of the packaging to the specified air pressure and to determine if there is leakage of air from the packaging. A packaging passes the test if there is no leakage of air from the packaging.

(4) *Solution over partial seams test.* For other than design qualification testing, the following test may be used for metal drums: The packaging must be restrained while an internal air pressure of 48 kPa (7.0 psig) is applied; the method of restraint may not affect the results of the test. The packaging must be coated with a soap solution over the entire side seam and a distance of not less than eight inches on each side of the side seam along the chime seam(s). The test must be conducted for a period of time sufficient

to pressurize the interior of the packaging to the specified air pressure and to determine if there is leakage of air from the packaging. A packaging passes the test if there is no leakage of air from the packaging. Chime cuts must be made on the initial drum at the beginning of each production run and on the initial drum after any adjustment to the chime seamer. Chime cuts must be maintained on file in date order for not less than six months and be made available to a representative of the Department of Transportation on request.

[Amdt. 178-97, 55 FR 52728, Dec. 21, 1990, as amended at 56 FR 66287, Dec. 20, 1991; 57 FR 45466, Oct. 1, 1992]

#### APPENDIX C TO PART 178—NOMINAL AND MINIMUM THICKNESSES OF STEEL DRUMS AND JERRICANS

For each listed packaging capacity, the following table compares the ISO 3574 (IBR, see §171.7 of this subchapter) nominal thickness with the corresponding ISO 3574 minimum thickness.

Maximum capacity (L)	ISO nominal (mm)	Corresponding ISO minimum (mm)
20 .....	0.7	0.63
30 .....	0.8	0.73
40 .....	0.8	0.73
60 .....	1.0	0.92
120 .....	1.0	0.92
220 .....	1.0	0.92
450 .....	1.9	1.77

[Amdt. 178-106, 59 FR 67522, Dec. 29, 1994, as amended at 68 FR 75758, Dec. 31, 2003]

#### APPENDIX D TO PART 178—THERMAL RESISTANCE TEST

1. *Scope.* This test method evaluates the thermal resistance capabilities of a compressed oxygen generator and the outer packaging for a cylinder of compressed oxygen or other oxidizing gas and an oxygen generator. When exposed to a temperature of 205 °C (400 °F) for a period of not less than three hours, the outer surface of the cylinder may not exceed a temperature of 93 °C (199 °F) and the oxygen generator must not actuate.

##### 2. *Apparatus.*

2.1 *Test Oven.* The oven must be large enough in size to fully house the test outer package without clearance problems. The test oven must be capable of maintaining a minimum steady state temperature of 205 °C (400 °F).

2.2 *Thermocouples.* At least three thermocouples must be used to monitor the temperature inside the oven and an addi-

tional three thermocouples must be used to monitor the temperature of the cylinder. The thermocouples must be 1/16 inch, ceramic packed, metal sheathed, type K (Chromel-Alumel), grounded junction with a nominal 30 American wire gauge (AWG) size conductor. The thermocouples measuring the temperature inside the oven must be placed at varying heights to ensure even temperature and proper heat-soak conditions. For the thermocouples measuring the temperature of the cylinder: (1) Two of them must be placed on the outer cylinder side wall at approximately 2 inches (5 cm) from the top and bottom shoulders of the cylinder; and (2) one must be placed on the cylinder valve body near the pressure relief device. Alternatively, the thermocouples may be replaced with other devices such as a remote temperature sensor, metal fuse on the valve, or coated wax, provided the device is tested and the test report is retained for verification. Under this alternative, it is permissible to record the highest temperature to which the cylinder is subjected instead of temperature measurements in intervals of not more than five (5) minutes.

2.3 *Instrumentation.* A calibrated recording device or a computerized data acquisition system with an appropriate range should be provided to measure and record the outputs of the thermocouples.

##### 3. *Test Specimen.*

3.1 *Specimen Configuration.* Each outer package material type and design must be tested, including any features such as handles, latches, fastening systems, etc., that may compromise the ability of the outer package to provide thermal protection.

3.2 *Test Specimen Mounting.* The tested outer package must be supported at the four corners using fire brick or other suitable means. The bottom surface of the outer package must be exposed to allow exposure to heat.

##### 4. *Preparation for Testing.*

4.1 It is recommended that the cylinder be closed at ambient temperature and configured as when filled with a valve and pressure relief device. The oxygen generator must be filled with an oxidizing agent and may be tested with or without packaging.

4.2 Place the package or generator onto supporting bricks or a stand inside the test oven in such a manner to ensure even temperature flow.

##### 5. *Test Procedure.*

5.1 Close oven door and check for proper reading on thermocouples.

5.2 Raise the temperature of the oven to a minimum temperature of 205 °C ± 2 °C (400 °F ± 5 °F). Maintain a minimum oven temperature of 205 °C ± 2 °C (400 °F ± 5 °F) for at least three hours. Exposure time begins when the oven steady state temperature reaches a minimum of 205 °C ± 2 °C (400 °F ± 5 °F).